Logistics Management Institute

Data Supporting the Screening Risk Assessment for the Anniston Army Depot Chemical Demilitarization Facility

CE417RD1

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LMI

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Study Objectives

The objectives of this study are to identify data element requirements and collection methods, collect Phase I screening information and demographic information, analyze Phase I data, and make recommendations about the use of U.S. Environmental Protection Agency (USEPA) default values or derive appropriate default values for use.

Introduction

Background

The Anniston Army Depot (ANAD) is a U.S. Army Armament, Munitions, and Chemical Command (AMCCOM) facility located in Calhoun County in northeastern Alabama; it is three miles east of the city of Anniston, Alabama. The depot encompasses 18,000 acres of land, most of which (80 percent) is woodlands, lakes, and streams. Approximately 10 percent of the facility supports active operations such as rebuilding and maintaining tanks and other heavy equipment, performing missile maintenance, repairing and rebuilding small arms and artillery, and supplying other materiel and services to the U.S. Army. The remaining 10 percent of the property is used for storing and servicing ammunition and lethal unitary chemical warfare agents. The depot has been in operation since 1941 and has been storing lethal unitary chemical agents since 1963. The depot is one of eight sites that stores lethal unitary agents in the United States.

In 1986, the Department of Defense Authorization Act was promulgated. It directed the destruction of the chemical agent munitions stockpiles by 30 September 1994. This act was amended in 1988 to allow for operational testing of a commercial-scale incineration project. The date for complete destruction of the stockpiles was extended to September 1997. On the basis of the results of an environmental impact statement, the chemical agent disposal method that appeared to provide the highest degree of safety and protection of human health and the environment was the on-site, high-temperature incineration method. Thus, the chemical agent demilitarization program initiated the design of the

incineration facilities and preparation of the required Resource Conservation and Recovery Act (RCRA) Part B permits for the hazardous waste incinerators.

In 1993, the U.S. Army Center for Health Promotion and Preventive Medicine, Provisional [USACHPPM(P)] was tasked by the U.S. Army Chemical Demilitarization and Remediation Activity (USACDRA) to perform multipathway human health risk assessments (HHRA) and ecological risk assessments (ERA) for the eight sites that store unitary chemical agents. The Logistics Management Institute (LMI) was requested to develop the screening-level risk analysis (SRA) data requirements for the ANAD proposed site.

Risk Assessment Requirements

The USEPA requires all RCRA Part B permit applications for hazardous waste incinerators to include a risk assessment (RA) that contains a multipathway HHRA and an ERA. Pursuant to the USEPA guidance, the RA uses a staged protocol that starts with a conservative SRA. The SRA is intended to provide the most conservative estimate of the potential risk, carcinogenic and noncarcinogenic, from direct exposures to combustion emissions and indirect exposures to contaminated soils, water sources, and food products. The SRA endpoints are estimates of individual risk for four specific exposure scenarios: a subsistence farmer, a subsistence fisher, an adult resident, and a child resident. For each scenario, the risk estimates are based on combining exposures and resultant risk for an individual contaminant of concern across several pathways. Where appropriate, risk from multiple contaminants of concern are also combined to provide overall estimates of risk for each exposure scenario. In the SRA for ANAD, 83 contaminants are of concern for which risk estimates must be calculated. The USEPA screening guidance also provides default values for most of the input parameters used in the SRA calculations, but it allows the use of validated site-specific data to modify the values for the input parameters, especially in the situation where default values would constitute implausible scenarios. The USEPA's levels of acceptable risk for an SRA are as follows:

- One per 100,000 population exposed (1E–5), is the plausible upper-bound estimate of the probability of an individual developing cancer as a result of a lifetime of exposure (70 years) to the modeled levels of carcinogenic emissions from the ANAD hazardous waste incinerator. The modeled levels are based on trial burn emissions measurements taken at the Johnston Atoll chemical agent demilitarization facility.

- For noncarcinogenic systemic toxicants, the hazard quotient (HQ) (e.g., the ratio of the total daily oral intake to an established reference dose) for the contaminant of concern or, when appropriate, the hazard index (HI) (e.g., the sum of the HQs of contaminants in a mixture) should be less than 0.25 of the reference dose. When HQs or HIs exceed unity (i.e., 1.0), there may be concern for potential adverse health effects.

Normally, the USEPA's acceptable level of carcinogenic risk is described as a risk range of one per 10,000 (1E–4) to one per million (1E–6) and the noncarcinogenic risk is any HQ or HI that does not exceed unity (i.e., 1.0). The levels proscribed for hazardous waste incinerator SRAs take into account that the unit may not be the only source contributing to exposures in the study area. Background exposure sources must be considered in order to avoid overestimation of allowable emissions levels, which could lead to unacceptable health risks to the public.

If the SRA results meet the acceptable risk criteria, then there is reason to conclude that further analysis of the risk from stack emissions is unnecessary. If the SRA results do not meet acceptable risk criteria, then phased demographic-specific (up to six levels) risk analyses must be completed. The phased risk analyses build increasing specificity into site data requirements only to the level required to verify compliance with the acceptable risk criteria. If none of the phased demographic-specific risk analyses meet the acceptable risk criteria, then the facility is denied the RCRA Part B permit.

Screening-Level Risk Analysis Data Requirements

The SRA algorithms use a combination of USEPA default data values and site-specific data values. The USEPA default values are used in the air dispersion and contaminant deposition modeling; calculating media concentrations for each of the exposure pathways associated with indirect exposures; and determining fate, transport, and uptake parameters for specific chemicals of concern. The site-specific data collection and evaluation focuses on hydrogeological, topographical/terrain, meteorological, facility operational, emissions, and exposure assessment data. The site-specific data is confined to an area encompassed by a 50-kilometer radiused circle about the operational facility. The USEPA requires that all default and site-specific data developed for use in an SRA be validated and referenced. The USEPA reserves the authority to dismiss any data values that it believes will lead to inappropriate estimates of risk. USACHPPM(P) and LMI personnel developed the data element requirements on the basis of a review of all USEPA guidance documents and their professional expertise in the RA arena.

The screening-level data parameters primarily focus on the potential for indirect exposures to emissions from combustion sources; however, they directly relate to the amount of stack emissions that may be entrained in ambient air and, thus, is available for human/animal inhalation and human dermal absorption exposures. Their primary use is for the determination of fate and transport plus wet and dry deposition of the emissions products into surface waters, onto soils, and onto standing crops that constitute an indirect human/animal exposure pathway from the food chain.

Again, four human exposure scenarios are used in the SRA: a subsistence farmer, a subsistence fisher, an adult resident, and a child resident. These exposure scenarios differ primarily in the consumption rates of contaminated foods.

In the subsistence farmer exposure scenario, the farmer is exposed by consumption of homegrown beef, milk, and vegetables; incidental ingestion of soil; and direct inhalation of vapors and particulates. Site-specific exposure parameters and data should be used, where possible, to modify the basic default values and exposure scenarios in the effort to avoid unrealistic risk outcomes.

The subsistence fisher is exposed by consumption of contaminated fish, homegrown vegetables, incidental ingestion of soil, and direct inhalation of vapors and particulates. Site-specific fish consumption patterns should be used to avoid being overly conservative in this exposure scenario. The uptake of contaminants by above-ground and root vegetables is an especially critical element of both of the subsistence scenarios.

For both the adult and child resident scenarios, the exposures are consumption of homegrown vegetables, incidental soil ingestion, and the direct inhalation of vapors and particulates. The exposure parameters must be chosen carefully in the child resident exposure scenario because the toxicity potential of the emissions products exert their effects during a 6-year exposure period rather than the 40-year exposure period used in the subsistence farmer scenario and the 30-year exposure period used in the subsistence fisher and adult resident scenarios.

Data Collection Methods

The data were collected by reviewing numerous data sources and contacting specific Alabama state, county, and municipal offices. Personnel contacted for the various data elements are listed with the applicable section of data. The list of data elements required was developed from the USEPA's *Methodology for Assessing Health Risks Associated with Indirect Exposure to Combustor Emissions* and its 1993a addendum, the *Revised Draft of Risk Assessment Implementation Guidance for Hazardous Waste Combustion Facilities* (USEPA 1994a); and the *Draft Guidance for Performing Screening Level Risk Analyses at Combustion Facilities Burning Hazardous Wastes,* (with all addendums such as USEPA 1994b, 1994c, 1994d, 1994e, and 1994f). We also developed a tabular array of the required data elements to facilitate data collection and to assist in data presentation (see Appendix).

CONCLUSIONS

The data presented in this report and the data provided under separate cover were validated with local, state, and Federal personnel for accuracy and representative of the ANAD area of concern.

FINDINGS

Sample Screening-Level Risk Analysis Calculations

We are providing a very simplified version of the RA calculations found in a typical SRA. In the examples, we use one of the semivolatile contaminants of concern, tetrachlorodibenzo-(p)-dioxin (TCDD). We are also using the modeled exposure concentrations for TCDD as they were calculated for the SRA at ANAD.

INHALATION CHRONIC DAILY INTAKE ADULT RESIDENT

A chronic daily intake (CDI) is computed only for use in the linear low-dose cancer risk equation:

$$CDI(mg/kg-day) = \frac{CA \times CF \times IR \times ET \times EF \times ED}{BW \times AT},$$

where

CA = contaminant concentration in air in milligrams per meter cubed of air (mg/m^3) = 1.77E–11 microgram (ug)/m^3 TCDD computed from the USEPA air model; this value is also used as the exposure (E) value in the noncancer HQ formula;

CF = conversion factor from ug/m^3 to mg/m^3 = 1 mg/1,000 ug;

IR = inhalation rate [m^3/hour (hr)] = 1 m^3/hr for an adult resident (i.e., the USEPA default value);

ET = exposure time [hr/day (d)] = 24 hr/d (i.e., the USEPA default value);

EF = exposure frequency [d/year (yr)] = 350 d/yr (i.e., the USEPA default value);

ED = exposure duration (yr) = 30 yr (i.e., the USEPA default value);

BW = body weight in kilograms (kg) = 70 kg (i.e., the USEPA default value); and

AT = averaging time in days = 70-year lifetime for toxic effects (i.e., 70 yr × 365 d/yr) = 25,550 days.

$$CDI\,(mg/kg-d) = \frac{(1.77E-11ug/m^3)(1mg/1,000ug)(1m^3/hr)(24hr/d)(350d/yr)(30yr)}{(70kg)(25,550d)}$$

$$CDI\,(mg/kg-d) = \frac{(1.77E-14mg)(2.52E+05)}{(1.7885E+06kg-d)}$$

$$CDI = 2.49E-15(mg/kg-d).$$

Linear Low-Dose Cancer Risk

The risk equation for linear low-dose cancer risks:

$$Risk = CDI \times SF,$$

where

CDI = chronic daily intake averaged more than 70 years (mg/kg–d);

SF = inhalation cancer slope factor of TCDD = 1.16E+05 $(mg/kg–d)^{-1}$; and

Risk = 2.49E–15 (mg/kg–d) × 1.16E+05 $(mg/kg–d)^{-1}$ = 2.89E–10. Conventionally, this number is rounded to the nearest whole number after completing the calculation. Therefore, the excess cancer risk due to emissions of TCDD = 3.0E–10 or three excess cancers per 10 billion persons exposed over a lifetime to this concentration of TCDD.

Noncancer Hazard Quotient

The noncancer HQ assumes that there is a level of exposure (E) [i.e., reference dose (RfD) for oral exposures and reference concentration (RfC) for inhalation exposures] below which it is unlikely for even sensitive populations to experience adverse health effects. If *E* exceeds this threshold (i.e., *E/RfD* or *E/RfC* exceeds unity), there may be concern for potential noncancer toxicity effects.

$$Noncancer\,HQ = E/RfC,$$

where

E = exposure level = 1.77E–11 ug/m^3 as modeled for TCDD;

RfC = 3.50E–06 ug/m^3 for TCDD, from the Integrated Risk Information System (IRIS). (This RfC for TCDD has been deleted from IRIS and is under review. It is used for example calculation purposes only.); and

$$HQ = 1.77E{-}11 \text{ ug/m}^3 / 3.50E{-}6 \text{ ug/m}^3 = 5.06E{-}6 \text{ or } 0.00000506.$$

Data Element Requirements

The data element requirements list developed for use in the SRA for the ANAD is as follows:

PHASE I

Screening Information

- Facility operational time period
- Average annual precipitation
- Average annual irrigation
- Average annual evapotranspiration (EV)
- Average annual surface runoff
- Universal soil loss equation rainfall or erosivity factor
- Total area for each body of water
- Impervious watershed area receiving deposition
- Total watershed area receiving deposition
- Average volumetric flow rate
- Depth of water column for each body of water.

Exposure Assessment Information

- General
  - Site-specific body-weight range
  - Monthly average air temperature
  - Sustained average wind speed, threshold wind speed
  - Types of produce grown in home gardens
  - Storm duration and length of time since previous rainfall

- Number of people who fish and/or hunt
- Types of recreation: swimming, golfing, hiking, camping, biking, and all-terrain vehicular activities.

- Soil
  - Plow depth
  - Soil types: soil texture, bulk density, organic content percentage, field capacity, and wilting point
  - Unit soil loss: rainfall index, soil erodibility index, length-slope factor, support practice factor, and management practice factor
  - Fraction of vegetative cover for each land use.

- Plant tissue
  - Crop-specific information: crop productivity, harvest yield of the crop, and area planted to crop
  - Leafy vegetables: height of plant from the ground, radius of plants, number of plants per row, number of rows of plants, distance between plants in a row, and distance between rows of plants
  - Round and long produce: number of produce per unit area, radius of produce, length of long produce, and length and width of unit area
  - Fruits: number of fruits per unit area, length of long fruit, and radius of round fruit
  - Length of growing season for each crop and produce item
  - Human daily ingestion of each produce group: leafy vegetables, above-ground protected produce, above-ground exposed round produce, above-ground exposed long produce, and below-ground produce.

- Animal tissue
  - Types of livestock: beef cattle, dairy cattle, pigs, sheep/goats, and chickens
  - Game animals that are consumed.

- Nursing infants
  - Number and location of breast-feeding mothers

- Number of infants born per year.

PHASE II

Other Exposure Assessment Parameters (If Demographic-Specific HHRA is Required)

- General
  - Population centers: locations and numbers
  - Locations of schools, nursing homes, and hospitals
  - Major employers and locations
  - Work schedule for employees within study area
  - Exposure duration for civilian and military residents
  - Current census information.
- Plant tissue
  - Number and location of crop farms, truck patch farms, and orchards; also types of produce grown
  - Ratio of produce grown within study area that is consumed versus exported
  - Source and location of irrigation water for farms and home gardens
  - Location of home gardens.
- Animal tissue
  - Locations and numbers of livestock farms
  - Numbers of livestock at each farm
  - Livestock water source
  - Percentage of grain and silage grown within study area versus the amount imported
  - Ratio of grain and silage grown within study area used to feed livestock versus imported grain and silage
  - Ratio of grain grown within study area fed to chickens versus amount of imported grain

- Amount of soil in grain and silage
- Average daily ingestion rate of grain, silage, and forage of each animal group
- Percentage of livestock that is consumed
- Ratio of livestock raised in the study area that is consumed versus imported
- Human daily ingestion rate of each animal group
- Human daily ingestion rate of each game animal
- Body fat percentage for each game animal.

- Surface water
  - Location, type, and use of body of water
  - Watershed delineation
  - Irrigation ditches: flow, average depth, and surface area
  - Percentage of stagnant surface water
  - Percentage of running surface water
  - Drinking water sources.

- Recreational
  - Locations of commercial and recreational fishing areas
  - Human daily ingestion rate of fish from area
  - Number of fish farms
  - Number of people who fish: subsistence and recreational fishers
  - Number of people who hunt and/or fish
  - Hunting location for each game animal
  - Recreation locations, recreation frequency, and recreation exposure time.

RESULTS

This section provides the data documentation for the SRA. On the basis of the data collected and analyzed, we believe the data values presented below and in the Appendix should be used in the SRA for ANAD.

Screening Data Parameters

The following parameters comprise the minimal essential required information used to complete the SRA for ANAD:

- Facility operational time period (USEPA default is 24 hrs/d for a 30-year time period).
- Average annual precipitation (**P**) = 135.0 cm/yr (from the Final Environmental Impact Statement Analysis, pages 3 – 8, USACDRA, May 1994).
- Average annual irrigation (**I**) = 32.0 cm/yr (from the United States Geological Survey data, 1994).
- Average annual **Ev** = 0.238 cm/yr (1967 Soil Survey, Randolph County, Alabama).
- Average annual surface runoff (**R**) = 50.8 cm/yr (Geraghty *et al., Water Atlas of the United States,* 1994).
- Universal soil loss equation erosivity factor (**RF**) = 332.5 1/yr averaged from the R values of the 10 counties of concern.
- Total surface area for each major body of water:
  - Coosa River, which includes Logan Martin and Neeley Henry Lakes. $\mathbf{WA_W}$ = 1.07E + 08 m^2 (based upon information provided by Andrew Shepard, Alabama Power, August 1994).
  - Eastaboga Fish Hatchery ($\mathbf{WA_W}$) = 8.50E + 04 m^2 (computed based upon information provided by James Cook, hatchery supervisor, October 1994).
  - Commercial catfish farm southeast of ANAD ($\mathbf{WA_W}$) = 7.28E + 04 m^2 (computed based upon information provided by Ms. Lennie Murphree, October 1994).
- Impervious watershed area receiving deposition ($\mathbf{WA_I}$) = 2.77E + 08 m^2 (USACDRA, 1989).

- Total watershed area receiving deposition ($\mathbf{WA_L}$) = 7.90E + 09 m^2, which is the area of a 50-kilometer radiused circle as required by the SRA.

- Average volumetric flow rate:

  - Coosa River, Logan Martin, and Neeley Henry Lakes (**Vfx**) = 9.00E + 09 m^3/yr (based upon information provided by Andrew Shepard, Alabama Power, August 1994).

  - Eastaboga Fish Hatchery (**Vfx**) = 4.03E + 06 m^3/yr (computed based upon information provided by James Cook, hatchery supervisor, October 1994).

  - Commercial catfish pond southeast of ANAD (**Vfx**) = 7.96E + 04 m^3/yr (computed based upon information provided by Ms. Lennie Murphree, October 1994).

- Depth of water column for each water body:

  - Coosa River, Logan Martin, and Neeley Henry Lakes ($\mathbf{d_W}$) = 4.42 m (data provided by Andrew Shepard, Alabama Power, August 1994).

  - Eastaboga Fish Hatchery ($\mathbf{d_W}$) = 1.22 m (data provided by James Cook, hatchery supervisor, October 1994).

  - Commercial catfish pond southeast of ANAD ($\mathbf{d_W}$) = 1.83 m (data provided by Ms. Lennie Murphree, October 1994).

Phases I and II Exposure Assessment Parameters and Data Values

Body Weight Ranges

Children, ages 1 to 6, 15 kg; adults, 70 kg; infants, age <1 year, <11 kg. Data extracted from USEPA's *Exposure Factors Handbook (EFH)*, risk-assistant exposure-assessment scenarios background defaults. Data are used in exposure uptake formulas, and in Phase II to identify risk-based subpopulations.

Monthly Average Air Temperature and Storm Event Data

Data was provided under separate cover from the National Climatic Data Center, Climate Services Division (based upon Anniston Regional Airport data station): 5 years worth of data plus analyses for average air temperature, average storm event, maximum storm event, and average time between storm events. Data is used in primary plume modeling: soils uptake, crop uptake of contaminants, soil erosion and runoff to surface waters, and body of water contamination formulas.

Sustained Average Wind Speed and Direction; Threshold Wind Speed

Data was extracted from environmental impact statement (EIS) analysis completed by USACDRA, May 1991. Data is used in primary plume modeling.

Hunting and Fishing Data

Data was provided under separate cover concerning potential exposures as a result of recreational fishing and hunting in Alabama.

Hunting

Hunting data summary is provided by the Alabama Conservation and Natural Resources, Division of Game and Fish. LMI used methods based upon total population affected (extracted from EIS) ratio to total population reported in *Alabama County Data Book, 1992 – 1993* to derive the percentage of hunters from affected counties versus the total number of hunting licenses sold. Percentage for affected counties is 0.0289. LMI then derived the number of licensed hunters in a 50-kilometer radius, man-days of hunting for 16 species, and the number of animals per species harvested or hunted per year. We also derived the amount of deer tissue ingested for each hunter, 64.84 lbs/yr based upon *EFH* average consumption values of 100 grams/meal × 4 persons eating at each meal, and reasonable maximum exposure (RME) consumption rates of 280 grams/meal × 4 persons eating at each meal, the total meals eaten (T) is T_{100} = 73.68 meals/yr and T_{280} = 26.31 meals/yr. Meals/yr = event/yr, which is used in the exposure intake formulas. The fraction contaminated (FC) based upon substituting deer tissue consumed for beef consumed in a year is FC_{100} = 73.68/350 = 0.21 and FC_{280} = 26.31/350 = 0.075; this last value would constitute an RME for the average hunter's family. For a subsistence hunter, the FC = 0.75, which is the *EFH's* default for beef consumption and simply reflects that the individual subsisting on homegrown beef is not anticipated to consume 100 percent contaminated products. The total deer intake for subsistence hunters should be set at the harvest figure of 29.47 kg. Although the USEPA risk methodology requires that the subsistence hunter exposure scenario be considered, the Alabama harvest statistics do not indicate the presence of subsistence hunting.

We recommend that the FC values and intakes presented above be used as demographic-specific values for the Anniston RA. This data will be used in various exposure scenarios and exposure intake formulas in the assessment. Information on small game hunting statistics was provided to Ms. Chang. Based upon the low numbers of small game of all species bagged per hunter, the overall ingestion quantities of all small game meat does not add any significant risk to the small game hunters because the T_{100} = 9.9 meals/yr and the T_{280} = 3.5 meals/yr. These figures for small game indicate that the T_{100} would represent 0.007 percent of the total meals eaten during the exposure period and the T_{280} would represent 0.002 percent of the total meals for the same time period.

Fishing

The data is derived from total population exposed versus total Alabama population. Percentage is still 0.0289. The total number of licenses issued in the affected area is 518,915 total licenses × 0.0289 percent = 14,997 fisher persons. Consumption data is taken from the State of Alabama Department of Environmental Management study, *Estimation of Daily Per Capita Freshwater Fish Consumption of Alabama Anglers,* August 1992 to July 1993. This publication represents site-specific ingestion data for 20 species of interest. The ingestion rates recommended for the Anniston study are based upon average values and upper 95 percent statistical confidence interval limits. By combining the two ingestion rate methods used in the study, the average ingestion rate for fish caught in the study area was 31.45 grams/d. The average ingestion rate for all fish caught in Alabama waters by the same personnel was 44.45 grams/d. This allows for a computation of an FC = 31.45/44.45 = 0.71. The highest consumption rate for anglers was 76 grams/d for those >50 yrs of age and should be considered a subsistence level of fish ingestion since the figure is also tied to family incomes <$15,000/yr. The FC for the subsistence group should remain at FC = 0.71. It should be noted that the mean body weight for all anglers (both male and female combined in the study) was 80 kg, and it is recommended that this number be used in place of the 70 kg default value from the *EFH*. The average fat content of the fish species available for recreational and subsistence fishing in Alabama waters is 2 percent.

TYPES OF PRODUCE GROWN IN HOME GARDENS

The default list was provided and approved by Ms. Chang on 11 October 1994. For ingestion rates, LMI recommends using *EFH* default values listed in Tables 2-6, 2-7, 2-9, and 2-10 of the *EFH*. This was discussed and approved by Ms. Chang on 11 October 1994. This method allows use of the *Alabama County Data Book* to derive the number of gardens per county using *EFH's* default of 33 percent for the south. Several exposure uptake and scenarios use this information for calculating residual risk.

TYPES OF RECREATION BY COUNTY

Data were obtained from the EIS and the Alabama Conservation and Natural Resources, Lands Division (parks). The data for the RA mainly pertains to fishing and hunting, but they also include inhalation exposures and dermal exposures while swimming. Data were provided on the basis of the number of user days/annum/park within the study area. With the use of the default data for recreation found in Tables 5-5 through 5-9 of the *EFH*, exposure durations for the swimming events may be calculated for the various age groups and exposure scenarios. The hunting and fishing days for exposure were provided from the sources noted in the hunting and fishing data above.

Soils Data

Soils data books for each county within the 50 kilometer radiused circle were obtained from the Alabama Soil and Water Conservation Department. Summaries of the physical and chemical properties of the soils within each county were also provided. For each county, soil types that were not conducive to agriculture, due to the high-slope range (>10), erosion index (>150), or length-slope factor values (>100) were eliminated from consideration. The narrative descriptions of the potential agricultural use of the soil types were used to validate the removal of these soils from agricultural use in the SRA. The remaining soils types for each county were analyzed for central tendency values for K values (i.e., erosion factor), length-slope values, organic matter percentage, and moist bulk density (using the first soil layer only 1 to 20 centimeters, 0.4 to 8 inches). These values are used in formulas for wet and dry deposition of contaminants in soils, plant uptake of contaminants, and soils contamination of surface bodies of water. The EIS listed the affected region as being 70 percent forested and 23 percent agricultural. The remaining 7 percent is comprised of built-up areas and miscellaneous. Each county lists its own figures for forest versus agricultural land, but the percentages will likely hover around the EIS data. LMI recommended that only the agricultural and pasture percentages be subjected to the crop contaminant portions of the RA and the erosion equations. Essentially, the forests are protected crops and are not subject to high erosion potential or wet/dry deposition rates of the contaminants. The data was provided under separate cover and was discussed and approved by Ms. Chang on 11 October 1994. The current value used for the screening assessment is 1.07E+08 m^2, obtained by the USACHPPM(P) from the Alabama Power Company. This number represents >41.31 square miles of surface water area, or approximately 0.014 percent of the total study area, which is 3,032 square miles and is a reasonable value for use in this RA.

Vegetative Cover

The data (extracted from the EIS) are as follows:

- Total area in 50-kilometer radius = 7.90E + 09 m^2
- Forest = 70% = 5.50E + 09 m^2
- Agriculture = 23% = 1.80E + 09 m^2
- Urban = 3.5% = 2.80E + 08 m^2
- Other = 3.0% = 2.40E + 08 m^2.

Erosion Data

Discussed under the "Soils Data" subsection above.

PLANT TISSUE

The data were provided by a fact sheet on Alabama agriculture, the *Alabama Agricultural Statistics Bulletin 36* (1992 – 1993), and from the EIS section on community resources. The major crops are listed by county along with the crop yields, number of producing farms, etc. The vapor transfer of contaminants to plant tissues seems to be a driver in the RA. Therefore, some of the planting practices data are required to calculate risks. The human daily ingestion data will use the default data from *EFH* Tables 2-6 through 2-10. The major agricultural plants for the study region are the following:

- Corn
  - Plants/acre = 20,000
  - Rows/acre = 83.5
  - Plants/row = 239.5
  - Height of plant = 6.5 ft
  - Radius of plant = 1.5 ft
  - Distance between plants = 10.44 in.
  - Distance between rows = 2.5 ft
  - Yield/acre = 107 bushels; a bushel = 22.4 kg; 157 kg/hectare = 2.5 bushels/acre; a hectare = 1×10^4 m^2; an acre = 4.047×10^3 m^2
  - Length of growing season = 210 days
- Soybeans
  - Plants/acre = 156,500
  - Rows/acre = 125
  - Plants/row = 1,252
  - Height of plant = 2.5 ft
  - Radius of plant = 2.0 ft
  - Distance between plants = 2.0 in.
  - Distance between rows = 1.67 ft

- Yield/acre = 35 bushels; a bushel = 22.4 kg; 157 kg/hectare = 2.5 bushels/acre; a hectare = 1×10^4 m^2; an acre = 4.047×10^3 m^2
- Length of growing season = 210 days

- Wheat
  - Plants/acre = 1,568,005
  - Rows/acre = 417.4
  - Plants/row = 3,756.6
  - Height of plant = 2.5 ft
  - Radius of plant = 4.5 in.
  - Distance between plants = 0.67 in.
  - Distance between rows = 0.50 ft
  - Yield/acre = 45 bushels; a bushel = 22.4 kg; 157 kg/hectare = 2.5 bushels/acre; a hectare = 1×10^4 m^2; an acre = 4.047×10^3 m^2
  - Length of growing season = 210 days
- Sorghum
  - Plants/acre = 52,279.35
  - Rows/acre = 83.5
  - Plants/row = 626.1
  - Height of plant = 3.0 ft
  - Radius of plant = 1.5 ft
  - Distance between plants = 4.0 in.
  - Distance between rows = 2.5 ft
  - Yield/acre = 45 bushels; a bushel = 22.4 kg; 157 kg/hectare = 2.5 bushels/acre; a hectare = 1×10^4 m^2; an acre = 4.047×10^3 m^2
  - Length of growing season = 210 days

- Peaches (Blount County only)
  - Plants/acre = 121 trees/acre
  - Rows/acre = 11
  - Plants/row = 18.97
  - Height of plant = tree (not provided)
  - Radius of fruit = 1.5 in.
  - Distance between plants = 12.0 ft
  - Distance between rows = 10 ft.
  - Yield/acre = 92 bushels; a bushel = 22.4 kg; 157 kg/hectare = 2.5 bushels/acre; a hectare = 1×10^4 m^2; an acre = 4.047×10^3 m^2
  - Length of growing season = 210 days
  - About 30 percent is consumed in the county; about 70 percent is exported
- Tomatoes (St. Clair County only)
  - Plants/acre = 86,819.2
  - Rows/acre = 417.4
  - Plants/row = 208.7
  - Height of plant = 3.5 ft
  - Radius of plant = 8.0 in., radius of fruit = 1.5 in.
  - Distance between plants = 1.0 ft
  - Distance between rows = .50 ft
  - Yield/acre = 41,250 lbs/acre; a hectare = 1×10^4 m^2; an acre = $4.047 \times 10^3 m^2$
  - Length of growing season = 210 days.

ANIMAL PRODUCTS

The data were provided in an Alabama agriculture fact sheet, *Alabama Agricultural Statistics Bulletin 36*, and the EIS section on community resources. The consumption factors from the *EFH* will be used to calculate average daily intake and lifetime average daily intake values. The data for the huntable species were derived by LMI. The USACHPPM(P) was advised to apply contaminant uptake concentrations to game animals by calculating uptake rates for 70 percent forested areas + 23 percent agricultural areas to daily food intakes of the game animals.

BREAST MILK

The data were provided to USACHPPM(P) by the county on the birth rates for the last 10 years and the percentage of mothers who breast-fed their babies. These data were obtained from Alabama's Women, Infants, and Children program. Ms. Chang was advised that the breast-milk contamination scenarios should be limited to an exposure duration of one year.

PERCENTAGE OF GRAIN AND SILAGE GROWN WITHIN THE STUDY AREA VERSUS IMPORTED

Grown	*Imported*
grain = 10 percent	grain = 90 percent
silage = 90 percent	silage = 10 percent

RATIO OF GRAIN AND SILAGE GROWN WITHIN THE STUDY AREA USED TO FEED LIVESTOCK VERSUS IMPORTED GRAIN AND SILAGE

Grown and Fed	*Imported and Fed*
grain = 10 percent	grain = 90 percent
silage = 10 percent	silage = 90 percent

RATIO OF GRAIN GROWN WITHIN THE STUDY AREA FED TO CHICKENS VERSUS IMPORTED GRAIN

Grown and Fed	*Imported and Fed*
grain = 10 percent	grain = 90 percent

AMOUNT OF SOIL IN GRAIN AND SILAGE

Zero percent for both.

Ratio of Livestock Raised in the Study Area That is Consumed

For cattle, hogs, and poultry, 5 percent is consumed and 95 percent is exported.

Other

Other demographic-specific data pertaining to population centers, locations of schools, nursing homes, hospitals, major area employers, and current census information was extracted from the EIS and the *Alabama County Data Book, 1992 – 1993* [provided under separate cover to the USACHPPM(P)].

Recommendations

We recommend the following:

- Use the data provided in this report and the data provided under separate cover as the basis for completing the SRA for ANAD.
- If further data specificity is required for these parameters, site visits to ANAD may be required.

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APPENDIX

Data Tables

Tables

Table A-1.
Risk Assessment Information — Anniston Army Depot (General)

Data elements	Potential data sources	Completed?
Body weight ranges Children: 1 to 6 yrs, 15 kg Adults: 70 kg Infants: < 1yr, < 11 kg	*Exposure Factors Handbook (EFH)*, EPA/600/8-89/043, March 1989, Table 5-2 (adults); Appendix 5A, Tables 5A-3, 4 (averaged 95 percent weight for infants < 1yr); *Human Health Evaluation Manual, Supplemental Guidance*, March 1991, p. 15, children weight and age 1 to 6 yrs	Yes
Monthly average air temperature, ^0F, by month for 5 yrs January: 46.5 February: 49.2 March: 54.7 April: 61.3 May: 68.8 June: 76.2 July: 80.1 August: 77.7 September: 73.6 October: 62.3 November: 52.2 December: 45.3	National Climatic Data Center (NCDC): Bill Skinner (704) 271-4800	Yes
Wind information Sustained average wind speed: 8.7 meters per second (m/s) Sustained common wind direction: SSW, NNW, N, S	Environmental impact statement (EIS)	Yes
Threshold wind speed: 0.0 m/s	EIS; EPA Risk Guide for Combustors	Yes
Storm information Average rainfall event: 0.144 in./day Maximum rainfall event: 1.8 in./day	NCDC information (see above)	Yes

Table A-2.
Risk Assessment Information — Anniston Army Depot (Fishing and Hunting)

Data elements	Potential data sources	Completed?
Fishing No. of licensed fishermen by co. Length of the fishing season Average no. of fishing days Average catch per fisherman *Counties* Calhoun Clay Talladega St. Claire Shelby Clayburne Blount Etowah Cherokee Randolph *Major fish species* Black bass Saltwater striper Walleye White/yellow bass Hybrid stripe bass Bream Rainbow trout Alligator gar Crappie	*Alabama Conservation and Natural Resources, Game and Fish Commission* Charles Kelly: (205) 242-3848 Bill Boon: (205) 242-3467, Enforcement Section Keith Guyse: (205) 242-3861, Wildlife Section Bill Reeves: (205) 242-3861, Fisheries Section Fred Harders: (205) 242-3881, Fisheries Section	Yes

Table A-3.
Risk Assessment Information — Anniston Army Depot (Hunting)

Data elements	Potential data sources	Completed?
No. of licensed hunters by co. Length of the hunting season by species Average no. of hunting days Average harvest by species *Counties* Calhoun Clay Talladega St. Claire Shelby Clayburne Blount Etowah Cherokee Randolph *Hunting species* Deer Hogs Turkey Squirrels Quail Bob white Dove *Waterfowl* Duck Goose Rails Snipe *Other* Raccoon Opossum Rabbit Coyote	*Alabama Conservation and Natural Resources, Game and Fish:* Charles Kelly: (205) 242-3848 Bill Boon: (205) 242-3467, Enforcement Section Keith Guyse: (205) 242-3861, Wildlife Section	Yes

Table A-4.
Risk Assessment Information — Anniston Army Depot (Produce)

Data elements	Potential data source	Completed?
Types of produce grown in home gardens (applies to all Alabama counties in grams dry weight per kilogram body weight per day)	*Alabama Agricultural Statistics Bulletin #29. EFH* Table 2-10, (p. 2-19), values for 50th percentile.	Yes
Area produce	*Consumption rate in grams/day (g/d)*	
Corn	60.9 g/d	
Lima beans	21.8 g/d	
Green (string) beans	15.1 g/d	
Potatoes	7.4 g/d	
Onions	0.7 g/d	
Tomatoes	14.6 g/d	
Lettuce	1.3 g/d	
Cucumbers	9.1 g/d	
Melons	9.6 g/d	
Cabbage (cooked)	8.1 g/d	
Strawberries	12.3 g/d	
Peaches	15.1 g/d	

Table A-5.
Risk Assessment Information — Anniston Army Depot
(Types of Recreation by County)

Data elements	Potential data sources	Completed?
National parks and state parks of Alabama: 22 parks in the area of concern (with numbers of visitors/year): Roland Cooper State Park – 51,628 Blue Springs Park – 39,069 Bucks Pocket Park – 33,866 Chattahoochee Park – 2,878 Chuha Park & Lodge – 270,900 Cheaha State Park – 93,680 Chicasaw State Park – 52,801 De Soto Park & Lodge – 318,511 Florala State Park – 62,591 Girlf Park & Lodge – 2,280,926 Joe Wheeler Park & Lodge – 797,874 Gunterville State Park & Lodge – 470,808 Lake Louleen Park – 89,508 Lake Point State Park & Lodge – 349,101 Klaud Kelly Park – 29,540 Mount De Santo State Park – 224,507 Oak Mountain State Park – 573,347 Meaher State Park – 33,426 Paul Grist Park – 4,113 Rick Wood Park – 78,636 Wind Creek Park – 316,455 Frank Jackson Park – 24,138	National Parks Bureau: 1 (800) 252-2262 Alabama Conservation and Natural Resources *Parks Division* Gary Leech: (205) 242-3484 Robert Smith: (205) 242-3987 Also, the Talladega National Forest would be expected to offer hunting, fishing, camping, and hiking activities. Other than the hunting and fishing data, there is no visitor use data on the national forest. We recommend use of the *EFH* Tables (5-4 thru 5-9, pages 5-11 to 5-29) to develop activity patterns for usage of parks	Yes

Table A-6.
Risk Assessment Information — Anniston Army Depot (Soil Data)

Data elements	Potential data sources	Completed?
Soil types Provide the average value for all soil types in the counties of concern for the following parameters: Moist bulk density (g/cm^3) = 1.41 Organic contents = 1.4 percent Slope length factor, LS = 0.61 Erosion factor (tons/acre), k = 0.32 Erosivity factor (1/yr), R = 332.5 *Vegetative cover* The fraction of vegetative cover for each of the following land uses: Total area in 50 km radius = $7.9E+9m^2$ Forest, 70 percent = $5.5E + 9m^2$ Agriculture, 23 percent = $1.8E + 9m^2$ Urban, 3.5 percent = $2.8E + 8m^2$ Other, 3.0 percent = $2.4E + 8m^2$ *Erosion data* Average annual runoff cm/yr – 20 in. = 50.8 cm/yr Soil mixing depth, cm = 20 cm	U.S. Geological Survey's soil books for the counties of concern. Alabama Department of Geological Survey: George Martin: (205) 349-2852 Alabama State Soil and Water Conservation Committee Steve Cauthen: (205) 242-2620 Ken Aycock: (205) 887-4525, Anniston Field Office Donald Ceay: (205) 236-2781, Anniston Field Office The soils books for Calhoun, Clay, Talledega, St. Claire, Shelby, Clayburne, Blount, Etowah, Cherokee, and Randolph counties were provided to the USACHPPM(P) See: EIS, Land Use Gerhaghty *et al.*, 1973 (See Bibliography) EPA's default for plow depth	Yes

Table A-7.
Risk Assessment Information — Anniston Army Depot (Plant Tissue)

Data elements	Potential data sources	Completed?
Crop-specific information for each major commercial crop grown in the state. Major crops are Corn Soybeans Peanuts Establish the major fruit and vegetable crops (also, see above for common crops) *Crop productivity* Bushels/acre *Harvest yield* Mass/area *Area planted to crop acres* Standing crop biomass kilograms dry weight per meter squared *Specific information on each crop species* *Leafy vegetables* Height of plant (cm) Radius of plant (cm) Planting practice Plants per row Rows per acre Distance between plants (cm) Distance between rows (cm) Length of growing season (days) *Round and long produce* Planting practices Number per unit area (yield) Radius of round produce (cm) Length of long produce (cm) Width of long produce (cm) *Fruits* Planting practices Number of fruit per unit area (yield) Length and width of long fruit (cm) Radius of round fruit (cm)	Alabama State Department of Agriculture and Industries: *Agricultural Statistics* Dave Klewno: (205) 279-3555. The USACHPPM(P) was provided with a fact sheet on Arkansas Agriculture, the *Alabama Agricultural Statistics, Bulletin 36* (1992 revised, 1993 preliminary); and the appropriate EIS section on "community resources." The following county extension agents were contacted for crop productivity information in their respective counties: for Blount — Dan Porch: (205) 274-2129 for Calhoun — Paul Mask: (205) 844-5490; John Henderson (205) 844-5488 for Clay — Billy Walker: (205) 354-2193 for Shelby — Nelson Wynn: (205) 669-6764 for St. Clair — Donald Lester: (205) 338-9416 for Talladega — Ronnie Williams: (205) 362-6187	Yes

Table A-8.
Risk Assessment Information — Anniston Army Depot (Human Daily Ingestion)

Data elements	Potential data sources	Completed?
Crops Segregated as shown below for each commercially grown crop: Leafy vegetables Above-ground protected produce Above-ground exposed round produce Above-ground exposed long produce Below-ground produce *Animal products* These are the major commercial animal products produced in Alabama: Cattle Hogs Dairy (milk) Chickens Turkeys Eggs Goats/sheep *Animals that are hunted* Deer Hog Turkey Squirrel Quail Dove *Waterfowl* Duck Goose Rail Snipe *Other*	See *EFH*. It provides information on the percentage of home-grown crops that people eat. We recommend using exposure factors from the *EFH* on amounts of each meat consumed. Use the formulas to calculate the amount of contaminant ingested. Again, county extension agents/services were contacted and asked the following questions: a. How much of each animal produce is raised in the county? b. Of the amount raised in the county, how much is consumed within the county? c. How much of that raised is exported and to where is it exported? (Similar questions were asked for each major crop produced in the county.)	Yes

Table A-9.
Risk Assessment Information — Anniston Army Depot (Birth Rates and Breast-Feeding)

Data elements			Potential data sources	Completed?
Five-year average of births by county plus percentage of women/infants/children participants who breast-fed their babies:			Alabama State Department of Public Health: Regional Office Anniston — (205) 236-3274 Health Statistics Group: Dorothy Harshbarger: (205) 242-4110	Yes
County	*Avg. births/yr*	*Percentage breast-fed*		
Calhoun	1,712	35.0		
Clay	170	29.0		
Talladega	1,115	24.0		
St. Clair	752	39.0		
Cleburne	66	34.0		
Cherokee	232	55.0		
Randolph	295	19.0		
Blount	535	57.0		
Etowah	1,308	37.0		
Shelby	1,712	44.0		

Note: The overall average for these counties is 37 percent of the mothers breast-feeding their infants. The statewide average is 30 percent.

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13. ABSTRACT ***(Maximum 200 words)***

In 1986, the Department of Defense Authorization Act directed the destruction of the chemical agent stockpiles by 30 September 1994. This act was amended in 1988 to allow for operational testing of a commercial-scale incineration project, and the date for complete destruction of the stockpiles was extended to September 1997. Based upon the results of an environmental impact statement, the chemical agent disposal method that appeared to provide the highest degree of safety to human health and the environment was on-site high temperature incineration. The chemical agent demilitarization program initiated design of the incineration facilities and preparation of the required Resource Conservation and Recovery Act, Part B, permits for hazardous waste incinerators.

In 1993, the U.S. Army Center for Health Promotion and Preventive Medicine (Provisional) was tasked by the U.S. Army Chemical Demilitarization and Remediation Activity to perform multipathway human health risk assessments and ecological risk assessments for the eight sites that store unitary chemical agents. The Logistics Management Institute (LMI) was requested to develop the screening-level risk analysis data requirements for the Anniston Army Depot (ANAD), Anniston, Alabama, proposed site. The data analyzed and/or derived for the ANAD screening-level risk assessment included: demographic data for ten counties; hydrologic data for all major bodies of water in the study area; analyses of soils' chemical and physical parameters; analyses of 10 years worth of meteorological data; and development of site-specific exposures assessment parameters for the study area. It was recommended that the data derived by LMI be used in place of the Environmental Protection Agency's default data parameters for many of the exposure values.

14. SUBJECT TERMS

Combustor; screening risk assessment; exposure assessment; carcinogenic risk; noncancer hazard quotient; chronic daily intake; cancer slope factor; reference dose/concentration

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